The PROGRESSIVE FISH-CULTURIST
News and Views from many Sources on Practical Hatchery Problems

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THE INDIVIDUAL AND THE PUBLIC SERVICE

DIRECTOR GABRIELSON DISCUSSES SERVICE POLICY WITH THE YOUNGER STAFF MEMBERS

THE FISH AND Wildlife Service is the major Federal agency charged with the responsibility of carrying out Federal activities in relation to all forms of wildlife. Probably these responsibilities and duties are as varied as those found in any agency in the Federal government. The origin of both the former Biological Survey and the former Bureau of Fisheries was, I believe, the same. Each started as a research agency, studying problems relating to fish and to wildlife. The Service now has administrative responsibility for both game and fish in Alaska, and for migratory birds throughout the entire country under the treaties with Great Britain and Mexico. It administers a great series of wildlife refuges and another great series of Federal fish hatcheries. Study of the relations of wildlife to agriculture and forestry led logically to efforts to increase desirable or beneficial species and to control those found to be destructive. In recent years there has grown up an understanding, by implication at least, that this agency should lead any fight to prevent the needless destruction of marsh land, timber land, streams, lakes, or any other habitat particularly valuable to wildlife. By order of the President we are required to inspect and pass on drainage propositions financed by Federal funds - a tremendous task as well as a tremendous responsibility.

I wish now to outline those fundamental considerations which govern the making of most policies and the decisions that are reached in special problems when these arise.

1. The first major policy that governs all our operations is that wherever we have administrative jurisdiction our legal and moral responsibilities compel us to consider the needs of wildlife first. Our main purpose and function is to insure the perpetuation of the crop of wildlife. Within that concept, privileges of taking must vary as the crop for any season permits. Great differences in the runs of salmon, which make up the major part of the Alaskan fishery crop, will

EDITOR'S NOTE: The leading article in the PROGRESSIVE FISH-CULTURIST this month has been condensed from a talk given by Dr. Ira N. Gabrielson, Director of the Fish and Wildlife Service, on February 24 at the opening session of a special in-service training course conducted at the Patuxent Research Refuge near Bowie, Maryland. The course is designed to give the new and younger employees a broad background of information on the functions of all branches of the Fish and Wildlife Service, as well as specialized training in the techniques of their own particular fields.

Approximately the first quarter of the talk by Director Gabrielson as here given has been condensed, and in the interest of brevity some departures from the original phraseology have necessarily been made. The balance of the talk, however, is presented entirely in the Director's own words.

inevitably compel drastic changes in Alaska fishery regulations from season to season. We have the same variations in migratory waterfowl. In making such decisions it is entirely probable that we may at times allow a greater or lesser harvest than we are entirely justified in doing, but these are instances of error in human judgment which no organization can avoid entirely. Giving the needs of wildlife first consideration remains the basic policy on which such administrative regulations are made.

2. In making such administrative regulations the policy is to distribute the privileges as fairly as possible among those who desire to take advantage of them. We try to avoid favoring one community over another, or one particular group over another. Here again it is impossible to satisfy them all. Each group or each community naturally wants to get the greatest possible return from the thing in which they are interested.

3. Another policy is that of encouraging State land-management agencies and other Federal agencies to provide for wildlife on the land or waters under their control, i.e., to consider the needs of wildlife in all of their programs insofar as they may do so consistently. Within these limits we have succeeded in obtaining a great deal of cooperation and in increasing the total area of habitat suitable for many species of wildlife.

4. Direct cooperation with State wildlife administrative agencies is another major policy. We have consistently urged that State administrative authorities be given wide latitude in handling wildlife problems; that they be given authority to set seasons, bag limits, and methods of harvesting the crop of game similar to that which we have under the migratory bird treaty act and in Alaska. This policy has been developed in recent years, or at least more successfully followed in recent years, than in the past. It should continue to be an integral policy of the Service.

An example of genuinely successful cooperation with State agencies is the Federal-State aid program, or the Pittman-Robertson program, which I consider the greatest piece of conservation legislation, after the migratory bird treaty act, enacted into Federal law. The 10 cooperative research units and the many other cooperative research programs under way with various State agencies are indications of a mutual and genuine desire to find more usable facts and information in the wildlife program.

5. A cardinal policy of the Fish and Wildlife Service is to encourage and promote cooperation with private agencies. Many of these have made notable contributions to the various conservation programs, and we should recognize that and work with them where we can. This does not imply that we invariably agree with everything they do. Occasionally some group adopts a program without sufficient investigation and of a type we cannot indorse or carry on as a part of our official activities. We should recognize the fact, nevertheless, that these people are genuinely interested in some part of the out-of-doors and encourage them to stay in that work and to perform, as far as they can, a suitable service in the general wildlife conservation program.

6. The sixth major policy of the Service and one that is of practical importance to you is the policy designed to develop a Service personnel with the highest standards of attainment. The fact that you are here today is evidence of our determination to do this. You are here to get instruction in the general work of this Service with the idea that it will help you to carry out the tasks that may be assigned to you. It is the definite policy of the Service to fill the higher-salaried jobs from within, but this does not mean that we will not go outside the organization for personnel if we find someone more competent than anyone we have. Such cases, however, are rare. If we can succeed in developing intelligent, alert personnel, adequately informed on the functions and work of the Service,

THE DIRECTOR

Dr.Ira N.Gabrielson was born in Sioux Rapids,Iowa,September 27,1889. He received the Bachelor of Science degree from Morningside (Iowa) College in 1912. He entered the government service October 1, 1915, as an Assistant Economic Ornithologist with the Bureau of Biological Survey. A few years later he was assigned to work in the field of rodent control in North Dakota and Oregon, becoming Regional Supervisor of Predator and Rodent Control in 1931. Three years later he was appointed directing head (in the Pacific Coast States) of the new Division of Game Management. In May 1935 he was brought to Washington,D. C., as consulting specialist to the Chief of the Bureau of Biological Survey and Assistant Chief of the Division of Wildlife Research, and on November 15, 1935, he became Chief of the Bureau. His appointment as Director of the new Fish and Wildlife Service became effective July 1, 1940.

Dr. Gabrielson is the author of 250 papers on birds, mammals, and botanical subjects. His most important scientific contributions are in the field of ornithology. In recognition of these contributions, the degree of Doctor of Science was conferred upon him in 1936 by Oregon State College.

the work will go forward with almost irresistible momentum. The ideal,of course, would be to have every individual in the Service so well posted on the functions, programs, and policies of the Service that he could answer intelligently any question that might be asked him. It will be a part of your job. This training course is an effort to help you know the work of the Service so thoroughly that you may speak up for it and defend or explain it as you have opportunities or occasions to do so.

I think I have now summarized the major over-all policies of the Service.

I am taking a little liberty with the topic that has been assigned to me by adding to this statement of policy and functions another section. How may you as a comparatively new member of the Fish and Wildlife Service most effectively help to promote these policies and the program that will be given to you later?

It may seem to you as a new member that you are a small and comparatively insignificant part of the Service which embraces some two thousand members. This is absolutely untrue, for you who are the younger workers are, in fact, the most important part of the personnel of the Service. Upon you, more than upon the older members, depends the future of the organization and its efficiency. You represent all those who must be ready to take up this work and carry it on from where we older ones leave off. You must furnish the new vision, the new courage, and the new understanding that will make this wildlife conservation program function effectively in the future.

Each one of you faces certain problems, personal and official, which you must solve before you can become an efficient and satisfactory member of the Service. One of the first of these requirements is that you develop a sense of loyalty to your Service. If you don't believe in the Service, or don't believe in the worthiness of its program, for your sake and that of the organization also, it would be well for you to get into some other work to which you can give enthusiastic support and loyalty. It is a very difficult thing to work efficiently unless deep in your heart you really believe in the program that you are working on. Loyalty to the Service does not necessarily mean agreement with everything that one's superiors may tell him, but it does mean supporting the policies and programs of the Service.

The first matter to be considered is that of your relation to the Service itself and to the personnel around you. It is obvious that one of the ways you can help promote the program of this organization is by doing well whatever task may be assigned to you. Whatever part you may have in the Service is important or the job would not be there. Someone has believed that you were qualified to do that work. If you justify that confidence and do a good job, one that will stand inspection both from within and from without the Service, you will be promoting the work of the Service and at the same time placing yourself in line for greater responsibilities.

You can help a great deal by remembering always that none of your fellow employees is perfect, and by making allowances for imperfections. You yourself are not perfect and none of your superior officers is. Each one of us makes mistakes, and will continue to do so as long as he tries to accomplish anything. You can help greatly by overlooking such mistakes and being helpful instead of critical. One of the commonest failings of persons in the Government service is the tendency to criticize other workers for small and trivial mistakes, at the same time overlooking or forgetting their own similar errors. The habit of criticizing other people for minor mistakes and talking about them either within or without the Service in derogatory terms is really a very ignominious way of trying to glorify one's self. It will help you greatly if you will try to avoid forming this habit. It is just as easy and much more profitable to be helpful to the other fellow. Give him a boost if you see that he is in trouble and try to help

him out rather than to add to his difficulties. I can tell you from 26 years of personal experience in the Service that it pays big dividends, and the rewards come sometimes in the most unexpected places. Many times people have repaid me for little kindnesses and little helps I gave them without any great trouble to myself. There is no room in a Governmental organization for petty jealousies and personal feuds.

What I have said about criticizing people in your own Service applies with equal force to those in other Services of the Federal and State governments. They also have difficult jobs to carry on. We do not know well the limitations or difficulties under which they may be working and it certainly does not speak well for us as public servants if we find fault with them. You will help greatly in perfecting team work by assuming a fair and friendly attitude toward your fellow public servants, and teamwork is really the thing that makes the program go. I would rather have in the organization one hundred good men who know how to work together effectively than a thousand brilliant individualists unable to coordinate their efforts. I think that any other responsible administrative officer would tell you the same thing.

Another major problem of adjustment that you will face will be that of your relations with the public. No matter how much you would like to do so you will not be allowed to forget that you are a public servant. As long as this country retains a democratic form of government the great American public will reserve to itself the right to criticize you. You should remember always that you are a servant of the people - not a master, and that you are working <u>for</u> the public - not <u>on</u> it. Even those having only the least authority must never forget that. Carrying a badge is no excuse for overbearing, discourteous or ugly behavior toward your fellow citizens. Getting into that attitude greatly handicaps a man in his work. The public has a right to be critical of you, and it is useless for you to attempt to retaliate in kind. It is a peculiar phenomenon that people will criticize a public servant for doing exactly the same things that they do themselves. This is one of the penalties that you pay for being in the public service. If you cannot learn to endure the slings and arrows of injustice and misunderstanding you will have a very difficult and unhappy time in the Service. It is important always that you be courteous in your relations with the public. Every letter you receive, no matter how abusive, should have a courteous reply, even though it may not deserve it. I cannot blame anyone for getting mad under an unprovoked attack. I do it myself and probably always shall. When you are feeling that way it is sometimes a good thing to dictate a reply to relieve your personal resentment, and then for the good of the Service mail it in the waste basket and write another one after you cool off. The standing of the Service in your community depends in large measure on how you conduct yourself in your relations with the public and also upon your personal conduct. What that personal conduct is to be is a matter for you to decide, but if you expect to be respected in the community you must live up to its standards and behave as do the better citizens in the community.

Each one of us has developed a certain philosophy, certain ideals, and has had a certain environment that makes him an individual, and we want to retain these characteristics. Your superior officers know the unique value of individuality and they want you to retain as much of that individuality as you possibly can without destroying the cohesion of the group you belong to. I cannot tell you how to make this necessary adjustment. I can only say that there are some brilliant persons so individualistically inclined that they can never work happily in any organization requiring teamwork. You may or may not be such an individual. If you are you will probably find that you are unhappy in the public service because you are unable to find a place where you can render any useful service.

Our organization must limit itself by the laws and regulations under which it works, and it is directly responsible to a public sentiment which is always changing. Each one of us, then, must adjust our activities and manner of thinking to the policies of the national Government, the Department, and the Service to which we belong. None of us can escape this requirement, no matter how high we go. You may think that in my position I am free to do as I please. I can tell you frankly that in all my 26 years with the Service there has never been a time when I was so little my own master as I am at present. If I am to help you, I must speak from personal experience. Like yourselves, I have faced the problem of making my personal beliefs conform to policies with which I did not agree, and I had to do this without sacrificing my intellectual integrity. When I learned certain things, they helped me to understand and adjust myself. Perhaps they may help you. First, you must understand that policies must be made on a broad basis. The Fish and Wildlife Service is a national organization. Its activities cover a territory from the Atlantic to the Pacific. The basic policies must be uniform and must confine themselves to the legal limitations under which we operate. They may not conform ideally to the needs of the Service but they represent the best that can be done under the conditions imposed. They probably won't always conform to the best needs of the unit to which you are assigned, and may even make your particular job more difficult, but from the national standpoint they have enough value in other areas to more than offset any inconveniences or difficulties they occasion you. When I finally learned and understood that truth it helped me to find my balance.

The second thing you must understand is that as a member of the Service you always retain your right to try to alter such policies by criticizing them intelligently in the Service. One of the worst things that you can do is to criticize them outside. Once I understood the exigencies on which many of these policies were based I learned that I could support them loyally even though I believed them to be wrong at certain points and under certain conditions.

Let me say again that the worst thing you can do is to criticize our policies to cooperators or to the public. You will gain no respect from them by doing so, and you will handicap the efficiency of the organization and damage it ultimately to your own disadvantage.

Another thing that helped me when I finally got it through my head was the fact that policies are evolutionary. They grow slowly. The major policies that we are following in the Service are the result of slow growth. They did not take form suddenly in someone's mind or spring full-mantled from the brow of Jove. They come as contributions from many members of the Service. They are not immutable. They change as conditions change. They change as a result of suggestions and criticisms from the personnel as well as from those outside. You can do the most good by offering intelligent suggestions and criticisms within the Service.

It is well for you to remember also that in an organization as large as this, with members scattered all over the country, we cannot change policies overnight. We may decide that we will do a certain thing but it will take many weeks of conferences and correspondence to get the plan in operation throughout the huge organization that we now have. Therefore we avoid making decisions suddenly. Rather we try to lay out certain basic policies and then give to the individuals in accordance with their responsibilities the task of making their actions conform to those broad basic policies. It is needless to say that this does not work perfectly. In each group we have very competent people, and others who are not so good. In one line they may do excellently; in another part, not so well. But we all do the best we can. As the organization goes onward policies change as the result of suggestions of the personnel and the knowledge we acquire from experience.

If you understand this I think it will help you to fit your own personal beliefs to the job and to your place as a member of the team.

One last thing I would like to emphasize. Those of us here in Washington have only one objective - to do the best job possible in wildlife conservation. We are anxious to help you find yourself. We are anxious to help you all we possibly can, although at times you may not think so. We wish to give you experience and opportunity to learn and grow. There are certain legal limitations under which we must operate, and when we insist upon your following certain routines and financial practices it is not necessarily because we believe that they are the wisest, most efficient, or most economical, but because we have no choice in the matter.

We are now starting a project which we hope will give you better opportunities to grow - to learn the Service, its programs, and its needs so that you may be a better employee and fit yourself for high and more responsible jobs. The extent of your opportunities will depend partly upon you and your interest and energy and the intelligence and enthusiasm with which you tackle the job, and partly on the amount of money available to expand the personnel to meet the increasing needs in our field of endeavor. Never in the history of conservation has the Fish and Wildlife Service or any other conservation agency had money enough to do adequately the job that was in sight. In many respects we are better off now than we have ever been before, but we are still working with inadequate equipment and tools, and no doubt we shall always be in that situation.

In conclusion I want to say to each one of you that this training school is an expression of our interest in you and in your career. We hope, too, that what you learn here will enable you to see new opportunities to benefit the Service.

FOOD OF BASS AND BREAM COMPARED

Bass and bream eat practically the same foods until the bass become large enough to capture and eat small fish, according to studies reported by H. H. Howell, H. S. Swingle, and E. V. Smith in the February 1941 issue of ALABAMA CONSERVATION.

Routine stomach analyses of fish taken in lakes and ponds throughout Alabama showed that in the fry and early fingerling stages bluegill bream eat micro-crustacea. As soon as their mouths are large enough, however, they begin eating small insects, which are their chief diet throughout life. Chironomid larvae and pupae occurred in 71 percent of the bream stomachs collected from all parts of the State of Alabama. All the stomachs examined were from fish weighing an ounce or more. Dragon-fly nymphs were second in importance. Other foods found in bream stomachs included caddis worms, Ceratopogonid larvae, plant fragments (Nais and Potamogeton), Mayfly nymphs, micro-crustacea, phantom-midge larvae, and water boatmen.

While the smallest bass eat micro-crustacea, they soon begin to include in their diet the smaller aquatic insects and then fry and fingerling fish. The only difference between the diets of 2-ounce and 2-pound bass is that the smaller bass eat smaller fish. In the stomachs of bass weighing 2 ounces or more, fish (mostly bream) ranked first in 80 percent of the stomachs analyzed and second in 6 percent. Dragon-fly nymphs were first in 20 percent of the stomachs. Midge larvae and adults of water boatmen also occurred frequently, and many other aquatic insects were eaten in smaller numbers.

MANAGING PONDS FOR FISH PRODUCTION

By H. S. Swingle and E. V. Smith
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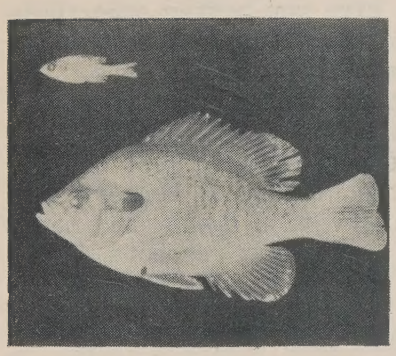
Auburn, Alabama



Both bluegills are 1 year old[2]

HUNTING AND FISHING have always been the two most popular outdoor sports in this country. As the population has increased and larger and larger areas have been devoted to various phases of agriculture, a corresponding reduction in the amount of fish and game usually has resulted. Today, over large areas of the United States, good hunting and fishing can be made available only by proper management. Because of the low production of game animals per acre of land, hunting necessarily can be enjoyed by only a relatively few people even under the best management practices. Fishing, on the other hand, can be provided for a large number of people by the construction of artificial lakes and ponds and by proper management of these new areas and natural bodies of water.

Fish culture, however, has tended to concentrate on the rearing of young fish in hatcheries, with little attention to developing principles for the management of bodies of water to increase fishing, and few definite experiments dealing with these problems are to be found in the voluminous literature put forth by fish-culturists.

Research was begun at the Alabama Experiment Station on some of the problems of pond management in 1934. At that time 20 small excavated ponds with areas of 1/130-acre and one 2-acre pond were constructed for the experiments. Since then, the ponds available have been considerably increased and at present approximately 25 acres of water in 81 ponds are being handled experimentally at Auburn. In addition, experiments on pond management are being conducted in various other sections of Alabama in 10 ponds ranging in size from 2 acres to 70 acres.

Bluegill bream (Lepomis macrochirus Raf.), largemouth black bass (Huro salmoides Raf.), white crappie (Pomoxis annularis Raf.), and bullhead catfish (Ameiurus sp.) are the principal fish which are well-adapted to pond culture in the Southeast, and work has been confined largely to these species. Experiments have dealt with methods of stocking, use of fertilizer to increase production, weed control, mosquito control, and the effect of various factors on fishing. Recommended pond management practices based on the stocking and fertilizing experiments will be discussed in this article.

In conducting the experiments, the desired numbers of each species of fish were counted, weighed, and placed in each pond. Every 2 weeks, water samples were removed for analysis, and each month the larger ponds were seined and samples of fish removed for food and growth records. At the end of the experiments the ponds

[1]Published with the approval of the Director.
[2]Upper fish represents average size from pond stocked with 180,000 fry per acre; lower fish average size from pond stocked with 1,500 fry per acre.

were drained, the species sorted, counted, and weighed, and samples preserved for permanent records. In draining the ponds a 20-foot draining box was placed against the lower end of the drain pipe and the fish were caught as they passed through. Removable net bags were used in the draining box to facilitate removal of the fish, which were then carried to a small holding pond, to be removed later, a few at a time, for sorting and weighing. (See photograph on page 11.)

STOCKING NEW PONDS

There is one excellent place for the use of hatchery fish, and that is a new pond. Best results cannot be obtained by stocking a new pond with a few brood fish. This usually results in overstocking the pond with certain species, while others may fail entirely to reproduce. Experimental ponds stocked in this manner have failed to produce satisfactory fishing during a 3-year period.

The importance of properly stocking a new pond cannot be over-emphasized. The manner in which a pond is originally stocked will affect the fishing for the next 5 to 10 years or longer. If properly stocked, a pond should furnish good fishing within 1 year or less; if improperly stocked it may require 5 or 10 years, or may never be satisfactory.

It is extremely important that ponds should not be stocked with too many fish. A pond will produce only a certain weight of fish, and consequently overstocking results in stunted fish which are unable to grow because of lack of food. It is apparent, therefore, that only the maximum number which can rapidly reach legal size should be added.

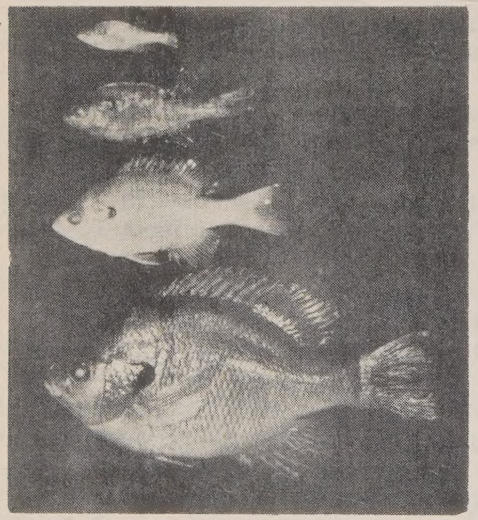
It is very important also that a pond be stocked with the correct combination of species. It is impossible at the present state of our knowledge to rear fish to legal size where only one species is present in a pond. For instance, if a pond is stocked only with the correct number of bluegills, the fish grow rapidly until spawning time. Each pair then produces several thousand young. Since the large bluegills will not eat any appreciable number of their own young, the pond is then so overstocked with fish that food is insufficient and growth ceases. The older fish soon begin to lose weight and a high mortality results. Ponds stocked in this manner have failed to produce legal-size fish during a 10-year period.

It is necessary, therefore, to add to ponds containing bluegills the correct number of carnivorous fish to eat most of the young fish produced. Those remaining will then have enough food. Largemouth black bass and white crappie were tested in experiments as the carnivorous fish. White crappie did not eat enough young bluegills or young crappie, with the result that the pond was overstocked with both the bluegills and crappie by the end of the year. Largemouth bass, however, reduced both the young bluegills and young bass to approximately the correct number for rapid growth. Largemouth black bass, or some similar species, are apparently necessary in all ponds in which it is desired to produce good fishing. They have been used successfully in combination with bluegills in ponds as small as 1/2 acre.

Since it is necessary,for best results, to add the correct numbers of several species, it is apparent that new ponds can be stocked properly only with hatchery-produced fish. The number of fish which should be added depends upon the number of pounds which the pond can support. In Alabama, unfertilized ponds support, on the average, about 150 pounds of game and pan fish per acre of water, while fertilized ponds support from 500 to 600 pounds. Results of various tests have indicated that on an average approximately 1/3 the total weight in a pond will be composed of carnivorous fish, and 2/3 of forage fish. In stocking, 1 bass is

Applying fertilizer to a small pond

added for each 2 pounds of carnivorous fish which the pond can produce, and 4 bluegill for each pound of forage fish. Each acre of water, if not fertilized, should therefore be stocked with approximately 400 bluegills and 30 largemouth bass; if fertilized, it should be stocked with not more than 1500 bluegills and 100 largemouth bass. If crappie are desired in the pond, approximately 1/4 the above number of bass may be replaced by an equal number of crappie. If catfish are wanted, approximately 1/4 the above number of bluegills may be replaced by bullheads, 25 bullheads being used for each 100 bluegills replaced.



Stocking with brood fish vs. stocking with fingerlings. The 3 bluegills at top show average size after 1, 2, and 3 years in a 1.8 acre pond stocked with 10 brood bluegills, 10 brood crappie, and 10 brood bass. The 4th fish shows average size reached in 8 months in a 1.3 acre pond stocked with correct number of bluegill and largemouth bass fingerlings.

Good fishing in the shortest time has been obtained by stocking in the fall or winter with bluegill and bass fingerlings as near the same size as possible. When stocked in this manner, bluegills reach legal size by the middle of the following summer and the bass by early fall. Fishing in such ponds should be begun as soon as the bass have reached legal size in order to reduce the number to be carried through the winter. When fingerling bass are used for stocking in the fall or winter, they reproduce successfully the following spring, and sufficient young bass are present in such ponds if most of the older bass are removed.

Where it is impossible to stock with fingerling bass and bream of approximately the same size, good results can be obtained by stocking with bream fingerlings in the fall or winter and bass fry the following spring. Under these conditions, growth of the bream is less rapid during the early summer as the bass fry are less effective than fingerlings

in reducing the number of young bream. In addition, no young bass can be produced in the pond till the following spring, and fishing should be postponed till that time. In experimental ponds stocked in this way, bass fry added in June reached a weight of 1 pound by November of the same year. About 90 percent of the bass added as fry were recovered as legal-sized fish when the pond was drained in November. Stocking with bass fry is very satisfactory, but necessitates waiting a longer time before the pond is ready for fishing.

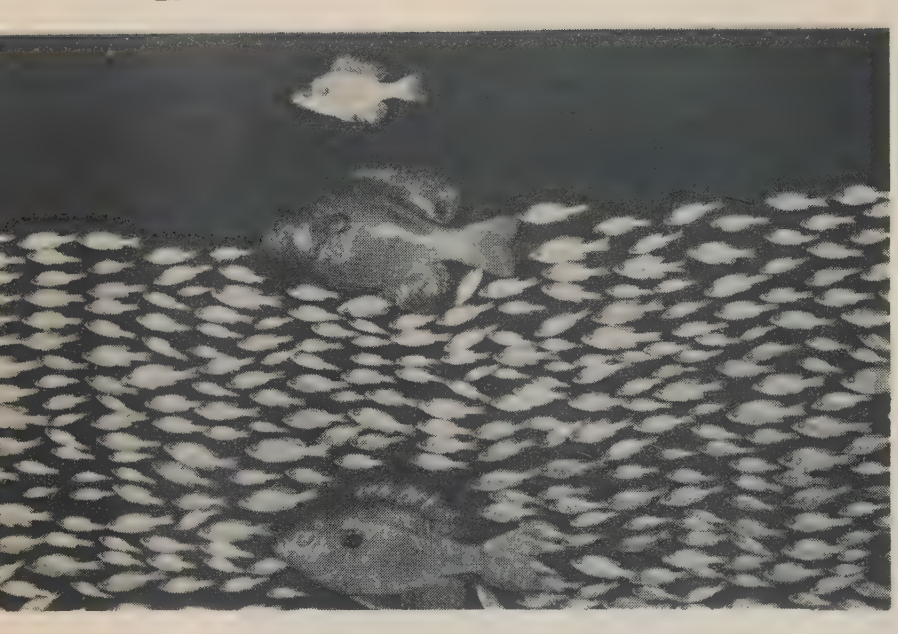
It is often recommended that bluegills be placed in a pond several years in advance of the bass. This should never be done as the pond is soon overcrowded with stunted fish, and bass are seldom able to reproduce successfully in a pond heavily overstocked with bluegills.

Draining a 2-acre experimental pond at Auburn, Alabama

IMPROVING OLD PONDS

After a pond has once been properly stocked with fish, it should not need the addition of more hatchery fish. Studies of the age and weight of fish from a large number of ponds in various sections of Alabama have been made, and in all cases growth was so slow as to leave no doubt that sufficient numbers of fish were present to utilize all the food in each pond. The addition of more hatchery fish would have been entirely valueless, except as a means of furnishing a few rather expensive mouthfuls for the carnivorous fish already present. An additional check on the above results was obtained by draining a number of ponds ranging in age from 3 years to 25 years. In all cases, sufficient young fish were found to utilize more food than the pond could produce.

The uselessness of restocking old ponds was demonstrated also by fishing records on an old 30-acre pond. For 3 years this pond was restocked with bass and for 5 years with bluegill bream from a 1/2-acre brood pond constructed on the



Results of stocking with bluegills only.

Upper: Average size stocked March 1938.

Center: Average size reached by June 1938 when spawning occurred. Each pair of bream produced an average of 4,000 young.

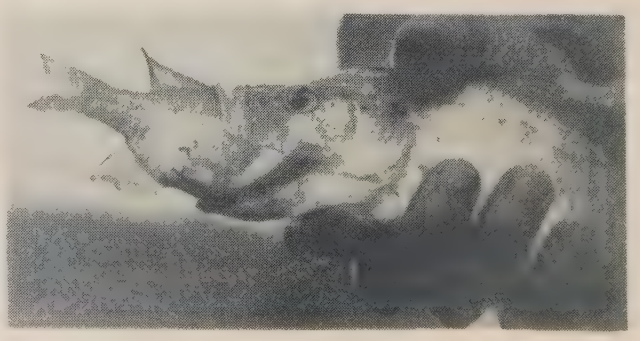
Lower: When pond was drained November 30, 1938, the large bream weighed only half as much as they had in June, because pond was overcrowded with their own young.

stream feeding the large pond. This heavy restocking failed to increase the catch of legal-sized fish in the pond; on the contrary, the catch actually decreased during the period. Restocking does not appear necessary as experiments at Auburn have shown that if 1 pair of bass, bream or crappie is present per acre of water, they can produce more small fish than the pond can support.

Poor fishing in most older ponds is not due to lack of sufficient brood stock. It is caused usually by a lack of sufficient fertility to produce the necessary food, by the absence of carnivorous fish, or occasionally by the presence of a considerable number of very large fish which upset the balance of the pond. Where carnivorous fish are absent, they must be introduced. Where forage and carnivorous fish are both present, good fishing can usually be produced by increasing the food supply for the fish through systematic application of fertilizer. If fertilization is begun in the early spring, fishing should improve by the middle of the summer, and should continue to improve throughout the rest of the year as fish are removed. When the cost of fertilization appears too great, fishing in old ponds can often be improved by draining the pond, removing the large or otherwise undesirable fish, and restocking with the correct number of small fish.

FERTILIZING FISH PONDS TO INCREASE PRODUCTION

Experiments (Swingle & Smith 1939)[3] have demonstrated that the production of fish in ponds can be greatly increased by building up the amount of plankton



The remedy for the condition shown above. Carnivorous species must be present in all ponds to reduce the number of small fish. This ambitious white crappie, trying to swallow a bluegill bream, was caught during the seining of an experimental pond.

[3] Fertilization for Increasing the Natural Food for Fish in Ponds. Trans. Am. Fish. Soc. 68, pp. 126-135. 1939.

present in the water by the use of commercial fertilizer. Unfertilized ponds in Alabama have been found capable of supporting between 70 and 200 pounds of game and pan fish per acre of water, while properly fertilized ponds will support between 500 and 600 pounds. The fertilizer treatment recommended below has been used in a large number of private and public ponds in the southeastern states for several years with excellent results. Proper fertilization of ponds results in very definite increases in the number and size of fish caught.

Amount of fertilizer per acre:--The following amounts of fertilizer are recommended for an acre of water at each application: 100 pounds of commercial 6-8-4 (N-P-K); 10 pounds of nitrate of soda. These are applied either separately or mixed before applying.

Where large amounts of fertilizer are required, a considerable saving results from the use of the following mixture instead of the above materials: 40 pounds sulphate of ammonia; 60 pounds superphosphate (16 percent); 5 pounds muriate of potash; 15 pounds finely ground limestone. These materials are mixed before applying.

Time and frequency of application:--The first application of fertilizer should be made in the spring as soon as the danger of floods is past (usually April or May in Alabama). If the pond has not been fertilized previously, 2 or 3 applications are then made at weekly intervals. Within a few days after the application of fertilizer, the water should become murky and should appear green or brown due to the growth of plankton. Other applications are made approximately every 4 weeks, or whenever the water loses this green or brown color and becomes clear enough for the bottom to be seen in 2 1/2 to 3 feet of water. The last application is made in September or October, and thus the ponds receive from 8 to 14 applications per year. The annual cost per acre varies from $11 to $20 and the cost of fertilizer per pound of fish produced varies from 3 to 6 cents. Ponds having the least amount of overflow water require the least fertilizer; similarly those receiving water from fertile land require less fertilizer than those receiving water from poor land.

Method of applying fertilizer:--In small ponds up to several acres in area, the fertilizer is applied by a person walking along the edge of the water and broadcasting it toward the deeper water. No attempt is made to cover the pond completely as wave action may be depended upon to distribute the plankton produced. In large ponds the fertilizer is broadcast from boats over the area where the water is from 1 to 6 feet deep. It should not be applied in deeper areas, as the material falling into the deep water is utilized very slowly by the plankton. The total area of the pond should be taken into consideration in calculating the amount of fertilizer required, as the plankton produced will be distributed over the pond by wave action.

Proof of successful pond management.

FORMALIN FOR BACTERIAL FIN ROT

By Roger E. Burrows
Fish and Wildlife Service
Quilcene, Washington

THE USE OF formalin in the treatment of the protozoan parasite Trichodina sp. (previously known as Cyclochaeta sp.), described by Fish and Burrows[1], was believed by the authors to be effective not only in the treatment of Trichodina but possibly of other external parasites of fishes as well.

During the summer of 1939, a series of epidemics of supposed bacterial fin rot affecting all species of fingerling trout occurred at the U. S. Fisheries Station at Quilcene, Washington. (Although the disease manifested the characteristics of bacterial fin rot, the causative organism was not identified nor were infected specimens examined by a pathologist). The standard treatment (copper sulphate, 1:2,000, 1 to 2 minute dip, recommended by Davis[2]), could not be used because of the toxicity of copper sulphate in the particular water used at the hatchery and also because of the advanced stage of the disease in some of the infected fish. Therefore, it was decided to experiment with formalin in the treatment of the disease suspected to be bacterial fin rot.

METHOD AND PROCEDURE

The method followed by Fish and Burrows in the treatment of Trichodina involved the use of pumps for the recirculation and aeration of the formalin solution. Since no suitable pump was available at the Quilcene Station it was decided to attempt treatment for the fin rot by holding the fish for the required exposure period (1 hour) in a solution of formalin and to rely entirely upon agitation for aeration.

In the treatment of Trichodina it was found that solutions of formalin varying in strength from 1:2,000 to 1:4,000 were effective in a 1-hour exposure. To develop a treatment for the supposed bacterial fin rot it was decided to try a 1:4,000 concentration of formalin for an exposure of 1 hour. Since this procedure proved entirely satisfactory no other methods of treatment were tested[3]. The formalin used in these treatments was the standard U.S.P. grade obtained from a wholesale drug company at a cost of approximately $1.75 per gallon.

The different groups of fish treated were held in troughs, rectangular ponds, and in a large circular pond. It appears advisable to describe separately the effect of treatments administered to fish in troughs and ponds.

Troughs.--The wooden troughs were standard hatching troughs measuring 16 feet long by 14 inches wide with an average water depth of 4 inches and a capacity of 43.4 gallons. It required 44 cc. of formalin to obtain a 1:4,000 concentration in this volume of water.

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[1] Fish, Frederic F. and Roger E. Burrows.
1940. Experiments upon the control of Trichodiniasis of salmonoid fishes by the prolonged recirculation of formalin solutions. Trans. Am. Fish. Soc., Vol. 69, pp. 94-100.

[2] Davis, H. S.
1937. Care and diseases of trout. U. S. Bureau of Fisheries, Investigational Report No. 35, 74 pp.

[3] All treatments were conducted under the direct supervision and with the complete cooperation of Mr. John Pelnar, foreman of the Quilcene Station.

Between July 14 and July 28, 1940, 135 thousand steelhead trout (Salmo irideus gairdneri) were treated with formalin for the disease that resembled fin rot. These fish were No. 1 fingerlings which had been feeding approximately one week. Eight thousand fish were held per trough (184 No. 1 fingerlings per gallon of water). Treatment was administered when the disease became apparent in the individual troughs during the 2-week period, care being taken to avoid contaminating a treated trough with equipment used in an untreated trough. Adequate aeration was produced by agitating the water at 15-minute intervals with a brush or by forcing the open end of a can up and down in the water of the trough. The fish showed no signs of discomfort. Probably the fish could have gone for longer periods without aeration but it was not thought prudent to allow them to show any signs of distress. Records of the mortality in individual troughs were not obtained. The fish responded very favorably to treatment and no abnormal losses occurred in any of the troughs treated.

On July 27, 1940, 12 thousand No.1½ to No. 2 fingerling eastern brook trout (Salvelinus fontinalis) also were treated in troughs for supposed bacterial fin rot. Six thousand fish were held in each trough (138 per gallon of water). The procedure in treating the brook trout was identical with that followed in the treatment of steelhead trout.

The brook trout fingerlings were the culls from a lot of 60 thousand fish and included the "pinheads", cripples, and stunted fingerlings. The mortality which had averaged 0.15 percent per day before treatment, increased to 0.49 percent the day after treatment. The second day after treatment the loss dropped to 0.18 percent and the average during the ensuing week was 0.14 percent per day.[4] Subsequently the losses became insignificant and the health of the fish improved rapidly.

Rectangular ponds.--The rectangular concrete ponds measured 20 feet long by 5 feet wide and during the treatments were drawn down to an average water depth of 8 inches (capacity, 561 gallons of water). The treatment required the addition of 320 cc. of formalin to provide a 1:4,000 concentration.

Twenty thousand brook trout fingerlings were held in each of two rectangular ponds, one containing the larger fish (No. 2) and the other containing the smaller fish (No. 1½). The No. 2 fingerlings first showed evidences of a supposed fin rot infection.

The larger fingerlings being held in one of the rectangular ponds at an average concentration of 35 fish per gallon were treated with formalin (1:4,000) for one hour on July 11. The water was aerated at 15-minute intervals by the method described previously and the fish at no time showed signs of discomfort. It is doubtful if aeration is necessary providing the number and size of fish per gallon of water in the pond is maintained at an optimum level.

The larger brook trout had a fairly advanced infection with the losses mounting consistently day by day until at the time of treatment the mortality had reached 0.30 percent per day. On the day after treatment the mortality rose to 0.45 percent, then subsided on the following day to 0.14 percent.

The smaller fish in the untreated rectangular pond showed evidences of the infection within the following week although the disease was not as far advanced as in the treated pond. In order to avoid the possibility of the larger fish having become reinfected since their treatment, it was decided to treat both ponds simultaneously.

Accordingly, on July 18,,the fish in both rectangular ponds were treated with formalin for 1 hour. The mortality remained the same the day after as on the day

[4]Percentages of mortality for the day of treatment were determined before exposure and thus the loss due to treatment was determined one day later.

of treatment,namely 0.15 percent. The second day after treatment the loss dropped to 0.09 percent and continued to decline gradually thereafter. No recurrence of the infection was noted in these fish during a 4-month period. The scars were completely healed and the dorsal fins entirely regenerated by the time of liberation.

Circular ponds.--The circular concrete pond was 44 feet in diameter and had an average water depth of 12 inches at the time it was used for treatment. At a depth of 12 inches the capacity of the pond was 11,360 gallons of water and 2.84 gallons of formalin were used to obtain the required concentration of 1:4,000.

The steelhead trout previously treated in troughs as No. 1 fingerling, together with 27 thousand untreated steelhead trout fingerlings, were placed in the circular pond on August 4. The untreated fingerlings were larger and older fish which had apparently escaped previous infection as they showed no evidences of the supposed fin rot when they were classed as No. 1 fingerlings. The younger steelhead trout had been treated with formalin solution before being placed in the circular pond and appeared free of infection at that time.

On August 25 the combined 159 thousand steelhead trout fingerlings in the circular pond (at an average concentration of 14 fish per gallon of water) were treated with formalin solution (1:4,000 concentration) for 1 hour. The entire lot showed evidences of what appeared to be bacterial fin rot with the larger fish carrying the heaviest infection. In some individuals the dorsal fin was destroyed and open muscular lesions were present on the backs of many fish.

The mortality in the circular pond had been increasing steadily and on the day previous to treatment it was 0.28 percent. On the day of treatment the loss was 0.15 percent. This apparent decline was due to an 18-hour lapse between recordings instead of the usual 24-hour lapse. The day after treatment the loss rose to 13.45 percent (21,460 fish) and subsequently dropped to 0.18 percent and 0.13 percent respectively the following 2 days. The mortality for the next 2 weeks averaged 0.15 percent.

The fish survived the 1-hour exposure to formalin solution satisfactorily but 3 hours later the losses mounted rapidly and reached a maximum 6 hours after treatment. From then on the mortality declined gradually until 24 hours after treatment the loss was normal.

Attempts to explain the unusual loss suggest two plausible alternatives: (1) Some factor such as oxygen deficiency or rapid change in carbon dioxide content may have been responsible. However, the facts do not tend to support this premise since the heavy loss probably would occur at the time of treatment and not 6 hours later. (2) That the formalin penetrated the open lesions of the more heavily infected fish and caused the mortality is undoubtedly the more logical conclusion. It was noted that the mortality was greatest in the more heavily infected fish, which during and after treatment appeared to be paralyzed posterior to the dorsal fin. That region turned much darker in color just prior to death. It seems reasonable to assume that the formalin penetrated the open lesions and in some way affected the nerve centers and thus caused the partial paralysis noted.

The fact that formalin killed the heavily infected fish is not, necessarily, a serious objection to its use. Davis (loc.cit.) recommended that the more heavily infected fish be destroyed prior to treatment with copper sulphate since they cannot be cured and are a constant source of infection. Formalin treatment apparently destroyed primarily those fish beyond cure and freed the remainder of all trace of infection and thus the results were entirely beneficial.

Further studies will be necessary to determine accurately the maximum number of fish that can be held per gallon of water in ponds and troughs and to ascertain the minimum concentration of formalin that would prove most effective in the treatment of fin rot or suspected fin rot.

AN EDITORIAL

THE VIRTUE OF ANONYMITY

THE PROGRESSIVE FISH-CULTURIST has received four letters commenting on "The Hatchery Log," published in the November-December number (52, p. 22). Two of them are presented elsewhere in this issue. One of the things that make our readers see red is the lack of signature on the article in question.

During its six-year life the PROGRESSIVE FISH-CULTURIST has published eight letters or articles that were unsigned or signed with an obvious nom-de-plume. Reputable papers do not publish anonymous communications. Unsigned letters only make one angry if they are considered at all.

Somewhat shamefacedly, we published five anonymous letters from an unknown correspondent during 1936-1938. The letters were, we believe, amusing but by no means pointless. In 1940 we published three such articles, each by a different author, which were, we believe, amusing but by no means pointless. These latter were not received anonymously as were the earlier ones but were signed and prepared with the Editor's knowledge. They were only published anonymously.

Well?

If someone questions the truth of your statements, the easiest and quickest retort is, "You're another !" If someone finds fault with your action, it is but human nature to reply that your critic did worse than that on such an occasion. This starts a real argument which immediately becomes personal, completely obscures the issues, and prevents a sensible consideration of the facts. Confucius say, "He who strike first blow has run out of arguments." The authors of these articles may not be afraid of brick-bats, but the Editor prefers thoughtful discussion.

One of the important functions of the PROGRESSIVE FISH-CULTURIST in aiding the sound development of fish culture and fish management is to promote constructive thinking on the part of all who are working toward the solution of the many problems that confront us daily. It is too easy in repeating the same task day after day to fall into an unthinking, mechanical routine. It is too easy to accept authority without question and to follow blindly. Progress does not originate with the top administrative officers alone. A questioning, enterprising spirit must pervade the entire personnel if an organization is to remain alive and grow in effectiveness.

The PROGRESSIVE FISH-CULTURIST is therefore alert to uncover new ideas, new facts, new principles, and new interpretations in our field and to point out shortcomings of thought or practice that hamper progress. These it passes on to its readers for trial, judgment, or adoption. Most of the offerings are backed by the experience or reputations of the contributors. Some of the ideas presented must stand alone upon their own merits, neither supported by big names nor damned by the frailties of human personalities. Thus the recent unsigned articles.

In "The Hatchery Log," the author, who is a fish-culturist of wide experience, does not criticize a Federal bureau or division nor any particular State hatchery or agency. He deals in symbolic terms with a general problem, exemplified in hatchery administration. It is the problem of petty officialdom stifling the initiative and enterprise of subordinate employees. It is a tip to administrators of all grades and in any branch of Government to look for and to foster talent close at hand.

On the other hand, the junior personnel must not be impatient if their ideas for improvement are not adopted immediately. Some of them may not be novel; long experience already may have proved them impractical. Moreover, as the Director has said (p. 6) policies in a large organization cannot be changed overnight. Instead of worrying about the superintendent's job, more thought should be given to improving performance in one's own position.

Glen Leach, head of the Federal hatchery service, recently said, "We have some superintendents like that in our organization - maybe five percent. But then, when the twelve disciples were chosen, one of them, or eight percent, went bad. Perhaps we're not so bad either." The States must have had the same experience.

So don't waste time trying to discover which superintendent in what particular service the unknown author of "The Hatchery Log" had in mind. Rather, search your own heart and examine your own record. Let no one wear shoes, even spiritual shoes, that do not fit lest they produce corns upon the soul.

Thus ends "The Hatchery Log."

The Editor.

CREEL CENSUS ON THREE TEST WATERS IN VERMONT

The total catch in Furnace Brook, Vt., during the 1940 season was 4,077 trout, of which 2,216 were brook trout and 1,861 rainbow trout, according to a summary of catch statistics by R. F. Lord. This figure exceeds the total catch for 1939 by approximately 1,000 fish. The number of fishing reports also showed a marked increase, being approximately 200 more than in 1939. However, in spite of the increased number of anglers, the average catch of 4.9 trout per fishing effort was identical with that of the previous year. It appears, therefore, that the larger catch in 1940 was due to an increase in the fishing effort and not to an increase in the available supply of trout. The 1940 record clearly shows the influence of a cold, backward spring on the fishing "pattern". The greatest number of fish were taken in July instead of during the first month of the season.

Naysmith Brook in northern Vermont was operated as a test stream for the first time in 1940. It is a typical mountain stream with an excellent reputation as a trout stream, but the total catch was only 1,498 fish, with an average of 2.6 trout per fishing effort. This stream has a resident rainbow trout population which provided 62 percent of the catch. As in Furnace Brook, only brook trout have been planted in this stream in recent years.

Statistics collected in Chittenden Reservoir, the only test lake, present quite a different picture. This lake has been stocked annually with yearling rainbow trout and during 1940 these fish made up 37.7 percent of the catch. Of this total 3.7 percent were planted in 1937, 13.8 percent in 1938 and 20.2 percent in 1939. These fish, planted in the fall at the end of the open season, gave better results than any fall plants of legal-sized fish in streams.

A census of the fish population was made in two sections of Furnace Brook where similar studies had been made in 1938. The total trout population in the two sections had been reduced from 149 in 1938 to 73 in 1940, a reduction of approximately 50 percent. Furthermore, the percentage of legal-sized fish had increased from 17 in 1938 to 38 in 1940. This decrease in the trout population is probably the result of the severe flood in September 1938. These figures are consistent with the decrease in the total catch, which was much less in 1939 and 1940 than in previous years.

A NEW FISH-TRANSPORTATION UNIT

JEFFERSON NATIONAL FOREST TROUT RIDE IN REFRIGERATED VAN

By Theodore C. Fearnow
United States Forest Service
Roanoke, Virginia

THE PROBLEM OF safely transporting live fish is not a new one. Hundreds of years of trial and error have been required to develop our present technique, imperfect as we find it to be at times. Even today we are constantly working with the twin factors, refrigeration and aeration, in our attempts to provide a better method for transporting live fish. In spite of the widespread use of refrigeration, it is doubtful if we have yet fully utilized the possibilities of accurately controlled and uniformly distributed cold in connection with fish transportation.

The unit described herein is now being operated in the Jefferson National Forest in Virginia. It was designed to fit a definite need in the Fish Management work of the Forest Service for a simple and mistake-proof equipment to transport trout from the Federal hatcheries to national forest waters. Upon arrival at the streamside, the fish are distributed on foot by C.C.C. enrollees.

Stream stocking work on the Jefferson Forest is handled as a cooperative enterprise between the Fish and Wildlife Service, the Civilian Conservation Corps, the Forest Service and the Virginia Commission of Game and Inland Fisheries. The Forest Stream Stocking Program is based on intensive stream surveys made by the former Bureau of Fisheries in 1934 and on supplemental surveys.

The program provides for annual stocking of most of the fishing streams, including many tributary waters that necessitate carrying fish by hand for considerable distances. Frequently it is found necessary to divide a single load of fish into many small lots to be carried by hand to such remote side streams. For this reason, the 5-gallon fish pail was adopted for use since it provides a convenient means for carrying fish to the point where they are to be released.

The special van-type body was constructed according to Forest Service specifications in a body-fabricating shop at Roanoke, Virginia. It is ruggedly built and designed to withstand constant use on rough mountain roads. Inside dimensions

Rear view of stocking unit with end gate raised.

of the body are: Length, 140 inches, width, 84 inches; height, 66 inches. It is constructed to provide the lowest possible mounting height on the chassis frame, thus facilitating easy loading and unloading of fish pails.

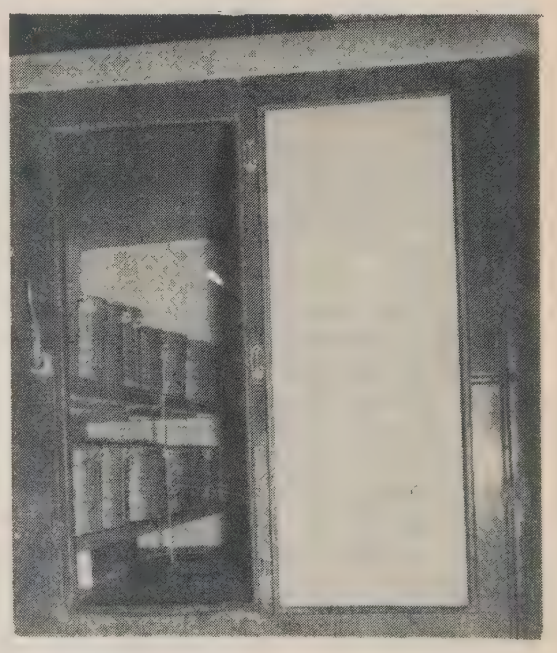
The floor and framing are native-grown air-dried oak, and both interior and exterior walls are waterproof plywood. The interior is lined with sheet metal, sealed and finished to withstand constant dampness from unavoidable overflow and melting ice. The exterior is covered with cold-rolled automobile sheet steel. Side walls and ceiling are insulated with heavy blanket type insulation. The roof is of plywood covered with one piece of heavy duty sail duck, filled and painted with three coats of aluminum to insure maximum heat reflection. The floor is insulated with a 3-inch thickness of corkboard and covered with galvanized sheet iron extending 12 inches up the side for a "flashed" joint. Four trap-type water drains are provided for water escape, thus eliminating entrance of warm air at these outlets.

On the rear of the unit a single middle refrigerator-type door, 20½ inches wide, is hung on chrome refrigerator hinges and secured with a 3-way refrigerator chrome lock. The door is constructed on the wedge principle, in order to provide a tight seal.

Ice for cooling the van is placed in the center aisle, close to the front wall. A single 300-lb. block of ice furnishes ample refrigeration for the entire load during normal summer weather for a trip of 100 to 150 miles. Compared with previous costs, when the same number of fish were transported on regular stake trucks using tarpaulin covers, expenditures for ice have been reduced by more than one-half.

A full width (84 inches) tailgate approximately 18 inches high was placed on the rear in such a manner as to permit free movement of the refrigerator door with the gate down. This gate is used as a loading platform, and is provided with fittings for attachment to the body when upright (closed) and a strong chain assembly for holding it rigidly in place when used as a loading platform.

Inside the unit, a special set of angle iron frames is provided to permit



Interior of stocking unit. Eighty pails of fish are carried on 4 shelf-type racks.

Care in transportation must be matched by care in planting.
Here a C.C.C. foreman directs the planting operation.

carrying 80 standard fish pails on 4 shelf-type racks. A center aisle runs the full length of the body, permitting easy access for loading, unloading and inspection. Removable wood-slat racks are built up in sections for use on the iron frame to provide a light and non-abrasive surface on which to place the metal fish pails. An electric light is provided for the interior of the unit, with a switch mounted inside the body near the door. This, along with the slat construction, permits ready inspection of any part of the load.

The unit is mounted on a 157-inch 1½-ton truck chassis of standard type, and is capable of maintaining a satisfactory speed over all the types of road conditions encountered in the mountains of Virginia.

In operating the new fish truck, it has been found desirable to keep a few hundred pounds of ice inside the unit overnight during periods when it is in daily use. By maintaining a low temperature in the unit, a load of fish is subjected to a "quick cooling" action, which lowers the temperature of water in the containers approximately five degrees (5° F.) within the first hour of transit. This has the effect of decreasing the physical activity of the fish, causing them to rest quietly at the bottom of the containers and consume a minimum of oxygen. At the same time, the ability of the water to absorb oxygen is increased as a result of the lower temperature.

Agitation produced by movement of the truck serves to provide aeration while the load is in transit. Stops of 30 minutes' duration or less are ordinarily made without harmful effects to the fish, once the temperature in the cans has been lowered 5° F., or more. However, experience has shown that the condition of fish when received at the hatchery has much to do with their ability to withstand delays and other hardships incident to transportation.

After a full season's use of the new unit, its advantages may be summed up as follows: (1) Fish are delivered to streams in better condition. (2) The number of fish carried per can is increased about 20 percent as a result of uniform reliable temperature control. (3) Important savings have been made in ex-

penditures for ice. (4) Fish may be held safely for periods long enough to permit careful planting. (5) The unit provides weatherproof storage, under lock and key, for complete fish distribution equipment.

On a second stocking unit, constructed for the George Washington National Forest, a special "bunker"-type, "air-induction" cooler has been installed. With this equipment 80 pounds of ice is placed in a special compartment attached to the front wall of the truck body. An electric blower draws air from the top portion of the body, forces it around the ice "bunker" for cooling, and exhausts it at the floor level. Water from melting ice in the "bunker" is discharged through a pipe which extends through the floor of the truck. By using this type of cooling unit in conjunction with the new insulated body, still greater efficiency is attained in the use of ice.

Because of the successful use of the "bunker" type cooler on Stocking Unit #2, a similar installation is being planned for use with the original stocking unit shown in the accompanying photographs. On this installation an adjustable thermostatic control is being added to maintain, automatically, the pre-selected temperature.

Lakes' "blooming," "turning over" and "cleaning themselves out" are three familiar lake behavior patterns important to fishing management. The bloom is the summer period in which microscopic free-floating one-celled plants are most abundant and give a blue, green, yellow, brown or reddish cast to the water. Some shallow protected lakes may bloom two or three times a summer, while larger colder waters may not bloom at all.

After a heavy bloom the microscopic and larger plants may die and rot, and even "ferment" with the formation of gas bubbles, usually in late August. Since the dead plants decompose quickly in the warm water, the lake soon "cleans itself."

A lake "turns over" when waters which have been in layers of different temperatures mix because of seasonal changes. In summer, on small sheltered lakes, warmer water remains on top. But when fall comes, water cooled to about 39 degrees is heavier than water either warmer or colder, and so sinks to the bottom, while ice and colder water remain on top through the winter. With the melting of ice and the warming of the water in spring, the fall turnover is reversed, and the waters again mingled.

EMPLOYMENT IN ICELAND

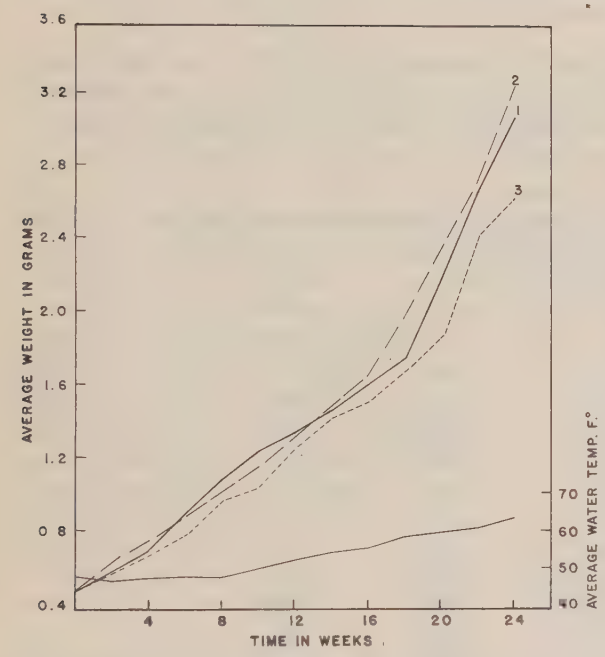
In the PROGRESSIVE FISH-CULTURIST No. 51 for July-October 1940, p. 10, reference was made to a possible opening for a trout-culturist in Iceland, and candidates were invited to send in their names. The PROGRESSIVE FISH-CULTURIST regrets to state that there has been no follow-up from Iceland on this matter, and no further information has been received relative to conditions of employment. It therefore appears that the proposal is dead and the PROGRESSIVE FISH-CULTURIST does not expect to take any further action on it. It is requested that this notice be taken as a reply to the numerous letters of inquiry received, and that we be excused from undertaking the labor of an individual reply to each.

BULK FOODS IN THE DIET OF YOUNG SALMON

By Lauren R. Donaldson
School of Fisheries, University of Washington
Seattle, Washington

and

Fred J. Foster
Fish and Wildlife Service
Portland, Oregon



Comparative average increase in weight of young chinook salmon fed on beef liver (Diet 1); liver, apple flour, and salmon meal (Diet 2); and liver, alderwood flour and salmon meal (Diet 3).

PREVIOUS EXPERIMENTS have pointed out the value of including apple flour, as a bulk substance, in the diet of young salmonoids that were fed diets containing a high percentage of food concentrates (Donaldson and Foster[1] and Foster et al[2]).

It is the practice of some of the European fish-culturists to include beechwood sawdust in the diets fed their fish, when these diets contain fish and animal meal concentrates, (Gaschott[3]). Beechwood sawdust was not available in quantity for our use, so alder sawdust was substituted and fed to one lot of fish (Lot No. 3) to obtain a comparison with apple flour.

This series contained 3 lots of fish, each confined to a separate trough. An initial total of 2000 young chinook salmon, that had just absorbed the yolk sac, were used in each lot. After 16 weeks experimental feeding the number of fish was reduced to 1000 fish for the remaining 8 weeks of the experimental period.

The fish in Lot 1 were fed a diet of 100 percent fresh beef liver. The fish in Lot 2 received a diet of 40 percent fresh beef liver, 40 percent Quilcene salmon meal and 20 percent apple flour. The fish in Lot 3 received a diet composed of 40 percent beef liver, 40 percent Quilcene salmon meal and 20 percent alderwood sawdust.

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[1]Donaldson, Lauren R., and Richard F. Foster.
1939. Some experiments on the use of salmon viscera, seal meal, beef pancreas, and apple flour in the diet of young chinook salmon (Oncorhynchus tschawytscha). PROGRESSIVE FISH-CULTURIST No. 44, pp. 10-17.

[2]Foster, Fred J., John Pelnar, and William Hagen, Jr.
1939. Preliminary results of an experiment on the inclusion of apple flour in foods fed to young salmonoids. PROGRESSIVE FISH-CULTURIST No. 47, pp. 49-51.

[3]Gaschott, Otto
1931. Some diseases of trout. (Translated by F. G. Richmond). Salmon and Trout Magazine, London. No. 64, pp. 273-282.

The beef liver used was obtained from a local packing company, ground and stored in a refrigerator. A fresh supply of liver was obtained at least once every two weeks. Meat not used immediately was kept in a frozen state until used.

All the dry ingredients of the diets used were ground to pass through a 32-mesh-to-the-inch seive. The dry foods were mixed with the liver and fed to the fish by passing the food mixtures through a small flour seive held above the troughs.

In feeding the fish, amounts given each lot were those found sufficient to produce growth at near the normal trend for the species used. The fish in Lot 1 were fed once each day and given the amount of liver they would consume without waste. The fish in Lots 2 and 3 (receiving mixed diets) were fed 40 percent by weight of the amount fed to the fish receiving liver, Lot 1. After the first 8 weeks (January 17 to March 13) the food given the fish in Lots 2 and 3 was increased to 50 percent by weight of the amount fed the fish in Lot 1. This increase was necessary to maintain a more nearly uniform rate of growth in the various lots.

The data on the cumulative mortalities, at 2-week intervals, for each lot, are presented in Table 1. The average weight of the fish in each of the experimental lots at 2-week intervals, based on weighed samples, is given in Table 2. A summary of results of the 24-week experiment is to be found in Table 3.

Table 1. Cumulative mortality figures for young chinook salmon experimentally fed on various diets, for 2-week periods beginning January 17 and ending July 3.

Period	Lot 1	Lot 2	Lot 3
1[1]	55	40	27
2	82	62	45
3	97	81	49
4	101	89	51
5	114	93	58
6	133	102	62
7	142	117	68
8	157	136	84
9[2]	46	24	18
10	73	34	29
11	79	44	37
12	92	55	47
Total mortality	249	191	131

[1]Initial number of fish, 2,000 per trough. [2]Number of fish reduced to 1,000 per trough.

The fish in Lot 1 produced growth and converted the food fed into fish as expected for the conditions of the experiment. The total mortality was 249 fish.

The fish in Lot 2 produced growth equal or superior to that of the fish in the liver-fed lot. The total mortality of the lot fed the mixed diet was 191 fish.

The fish in Lot 3 did not grow as rapidly as the fish fed apple flour. This was especially true during the later part of the experimental period (Fig.,p.23).

The combination of substances fed Lot 3 produced a mixture that was too dry for optimum feeding results, especially with the larger sized fish. (Subsequent work has indicated that this combination can be improved by the reduction of the liver to about 25 percent of the total and the addition of 25 percent fresh beef blood. The blood and liver when mixed with 50 percent meal mixture, produces a food that can be fed with less loss.)

Table 2. Average weight in grams of chinook salmon fingerlings, based on samples weighed at 2-week intervals

Date weighed	Lot 1	Lot 2	Lot 3
January 17	0.49	0.49	0.49
January 31	0.61	0.67	0.60
February 14	0.71	0.77	0.70
February 28	0.92	0.91	0.80
March 13	1.11	1.04	1.02
March 27	1.27	1.19	1.05
April 10	1.36	1.36	1.28
April 24	1.49	1.51	1.46
May 8[1]	1.63	1.68	1.51
May 22	1.77	2.00	1.70
June 5	2.19	2.39	1.87
June 19	2.69	2.72	2.49
July 3	3.10	3.27	2.62

[1]Number of fish reduced to 1,000 per trough.

Table 3. Summary of experimental feeding tests with chinook salmon fingerlings at the University of Washington experimental hatchery

Item	Lot 1	Lot 2	Lot 3
Initial average length (cms.)	3.35	3.35	3.35
Average length at report (cms.)	6.01	6.08	5.76
Percentage gain in length	79.40	81.40	71.90
Initial average weight (grams)	0.49	0.49	0.49
Average weight at report (grams)	3.10	3.27	2.62
Percentage gain in weight	533.00	567.00	435.00
Condition factor	1.43	1.45	1.37
Mortality figure[1]	157.00	136.00	84.00
	92.00	55.00	47.00
Percentage mortality[1]	7.90	6.80	4.20
	9.20	5.50	4.70
Total weight of food fed (grams)	13,412.00	6,415.00	6,415.00
Efficiency factor	0.24	0.56	0.46
Pounds of food to produce 1 lb. fish	4.17	1.79	2.17
Cost for food per lb. of fish	$0.334	0.091	0.106

[1]The upper figures are based on 2,000 fish and cover the first 16 weeks; the lower on 1,000 fish and cover the last 8 weeks.

The addition of the alder sawdust was beneficial in reducing the mortality rate, for the fish in Lot 3 suffered a mortality of only 131 fish.

Assuming a cost of $0.08 a pound for liver, $0.04 a pound for Quilcene salmon meal, $0.015 a pound for apple flour, and $0.04 a pound for alderwood sawdust, the food cost per pound of fish produced was $0.334 for the liver-fed lot, $0.091 for the lot fed the diet of liver, salmon meal and apple flour, and $0.106 for the lot fed liver, salmon meal, and alderwood sawdust.

Additional experiments should be instituted to evaluate the problem of the addition of bulk substances to the diets of young salmonoids. In addition to the evaluation of the products available, optimum levels for feeding such substances should be ascertained.

CONSERVATION AT THE HEADGATE

SCREENING IRRIGATION DIVERSIONS AN IMPORTANT PHASE OF WESTERN FISHERY MANAGEMENT

By R. R. Gardner
Glenrock, Wyoming

THE SUBJECT OF this paper, "Conservation at the Headgate" is unusually important and in attempting to deal with it adequately I find myself "between the devil and the deep blue sea." On one hand fishermen are clamoring for action to stop the loss of fish through irrigation diversions and on the other stockmen and farmers are resisting with determination the enforcement of the fish-screen law of Wyoming.

The laws of the State of Wyoming contain what would appear to be an adequate basis for compelling the adoption of satisfactory methods of protecting fish in connection with irrigation canals and ditches:

> "DITCH OWNERS TO PROTECT FISH. It shall be the duty of every person, corporation or company who shall construct, maintain or operate any ditch or canal pursuant to the laws of this State, to construct and maintain, at the point and place where the water is diverted from its natural channel, some fit and proper obstruction whereby all fish will be prevented from entering said ditch or canal. Any person, company or corporation violating the provisions of this section shall be adjudged guilty of a misdemeanor, and on conviction thereof shall be punished by a fine of not more than one hundred dollars ($100), or by imprisonment in the county jail not less than ten nor more than sixty days, or by both such fine and imprisonment." (Section 122-1204 W. R. S. 1931).

It would be very simple for me to suggest the enforcement of this law and let it go at that, but the problem would not be solved. You will observe that the law affirms that it is incumbent upon the farmer or rancher to construct and maintain

[1]Condensed from an address delivered to the Wyoming Convention of the Izaak Walton League of America, August 9, 1940.

some fit and proper obstruction whereby all fish will be prevented from entering said ditch or canal. The cost and responsibility of constructing and maintaining fish screens are thrown entirely upon the shoulders of the owners of the ditch or canal. These men are not interested primarily in the conservation of fish but in securing an adequate supply of water for irrigation at the least possible expense.

The problem is not simple but has several aspects, each of which must be considered in any attempt to effect a satisfactory solution. These are: (1) Loss of fish through irrigation ditches and canals. (2) Conditions at the outlets and headgates through which the fish pass. (3) The attitude of the water user toward screening. (4) The responsibility of the water user with respect to screening. (5) The obligation or duty of the Fish and Game Commission to assist in the screening of diversions. (6) The development of effective screens that may be installed with a minimum expenditure.

There is a great diversity of opinion, especially among water users, concerning the number of fish lost annually through the diversion of natural waters into irrigation canals and ditches. Certain ranchers believe that many fish find their way back from the diversion into the main stream, especially during periods of low water. Others hold the opinion that fish will find deep water and will migrate toward it whether in the stream or in a canal. I, however, am convinced both from personal investigation and from the opinions expressed by water users, that millions of fish are lost annually through irrigation diversions. It is incumbent upon our Fish and Game Commission to make a thorough study of the problem in order that intelligent action may be taken to curtail the loss.

I believe that it is practically impossible to enforce the present screen law of the State of Wyoming. I am sure that, because of the cost of installing and maintaining proper screens, irrigationists cannot be forced to install and maintain adequate devices. Water users seem to have the general attitude that while they have every right to use the water that actually belongs to the State, to expect them to bear the cost of protecting the fish is an unwarranted burden. The State of Oregon has had similar difficulties in enforcing its laws--and some cases that came to trial were lost, presumably because the farmer juries were not sympathetic toward the screen law. In California, however,I have been informed that a case involving the non-observance of the law requiring the installation of fish screens was appealed to the Supreme Court. The Court held that the law was valid and enforcible. Following this decision, however, California amended the law to provide for payment of one-half of the cost of installing, operating, and maintaining screens by the Division of Fish and Game. A bill is now pending in the California legislature under the provisions of which the Division of Fish and Game will be permitted to construct, at its own expense, fish screens on ditches where the water is used primarily for agricultural purposes. All other water users will install screens upon order of the Division at their own expense, and all screens, regardless of how installed or financed, will be operated and maintained by the ditch owner. Laws of this nature appear to me to be more practical than our present Wyoming law, and it might be advisable to have a revised law drafted and submitted to the next session of our legislature.

In order to be successful such a revised law will have to meet with the cooperative approval of the Fish and Game Commission, various organizations of sportsmen throughout the State, stock growers, farmers' associations, and individual irrigationists.

I have procured all data available pertaining to types of screens used in various States. The rotary or drum type is probably the most successful although objections to it have been raised on the grounds that it is expensive to install, troublesome to maintain, and frequently is inefficient or ineffective. The cost of installing one of the better types of rotary screens is almost prohibitive

from the standpoint of the water user. Installations probably should be financed jointly by the user,the State agency, and the Federal Government (if it has interests involved).

A great deal has been written concerning the quantities or numbers of fish that are lost annually through irrigation diversions and there is a diversity of opinion on the subject. Certain states have made definite surveys that indicate the loss to be tremendous and I could quote their actual figures if space and time permitted. For example, the former Bureau of Fisheries (now a part of the Fish and Wildlife Service of the United States Department of the Interior) made a survey of the losses that occurred in irrigation ditches supplied by the Yakima River in Washington, and reported the recovery of 4,000 fish, 90 percent of them migrating salmon, in a 200-acre tract. For the 250,000 acres then under irrigation this rate of loss would indicate that approximately 5 million fish were lost at one watering, and approximately 4½ million were salmon in their first and second years of life. In an entire season these figures would be multiplied many times. The Wyoming Game and Fish Commission has stated that it has no means of estimating the number of fish that survive after planting, but believesthat loss through irrigation laterals is one of the greatest causes of mortality. I have personally investigated irrigation ditches and have found many small fish stranded. In one instance a rancher found 12 fish in his garden one morning, four of them trout approximately 12 inches long. He also informed me that he had seen many large as well as small fish in his ditches and laterals.

Investigations of State and Federal agencies have disclosed that there is a greater loss of small fish than of large fish through irrigation diversions due to the fact that the small fish are inclined to drift with the current. It seems useless to spend thousands of dollars each year to hatch, rear, and plant fish only to have them lost in irrigation diversions. It would seem to be a good business policy for the Game and Fish Commission to use some of the money ordinarily expended in fish propagation for the purpose of screening headgates of diversions. It has been estimated by one fish hatchery that it costs 30 to 40 cents per pound to raise and plant fish. Fish through the headgates make an excellent,but extremely expensive, fertilizer.

After studying the problem from every angle, I feel justified in making the following recommendations:

1. The Game and Fish Commission and the various sportsmen's organizations throughout the State should attempt to build up sentiment among irrigationists in favor of fish conservation.
2. A special committee should be appointed by the Game and Fish Commission to work with committees from sportsmen's organizations to study and report on the most economical, feasible and practical fish screen for installation at headgates and in diversions, and to make recommendations concerning maintenance and operation.
3. The Game and Fish Commission should make surveys of all irrigation ditches and canals in the State that divert water from fishing streams and should outline a systematic plan of screening.
4. The outlets through which we sustain our greatest fish loss should be screened first.
5. Each stream selected to be screened should be completely protected before installations are attempted on another stream.
6. Cooperation should be extended to the Fish and Wildlife Service in their fish-protection work and attempts should be made to procure Federal assistance in financing projects.

7. A committee of Wyoming members of the Izaak Walton League should be appointed to work with a similar committee of the Game and Fish Commission to propose a revision of the present law of Wyoming relative to screening ditches to provide that all or part of the cost of installation and maintenance should be borne by the Game and Fish Commission or by agencies responsible for the construction of power and irrigation projects.

8. The Doyle screen, used in Montana, should be investigated since it appears to be one of the most practical and economical screens that may be installed.

The objectives and purposes of the Izaak Walton League are not dissimilar to the objectives of the Game and Fish Commission of Wyoming and if members of the two organizations will work together much good can be accomplished. We know that fish make excellent fertilizer, but I am of the opinion that none of us is anxious to see them used for that purpose. Surely, if we are to maintain good fishing in the State of Wyoming we must work earnestly and diligently to eliminate the fish losses and to provide additional means of conservation.

MULLET CULTURE IN CHINA

Successful cultivation of the grey mullet in association with several species of pond carps is described by S. Y. Lin in the September 1940 issue of the Journal of the Hong Kong Fisheries Research Station (pp. 161-193, "Fish Culture in Ponds in the New Territories of Hong Kong"). Two methods of mullet culture are practiced in China, according to Lin. The first is the practice, common throughout the world, of keeping mullet in inclosed areas on the edge of brackish water bays, without giving prepared foods. The second and comparatively new method is that of introducing mullet into established communities of pond carps under semi-controlled conditions.

As on the South Atlantic Coast of the United States, the grey mullet of China is thought to spawn in the sea, probably from November to March. The fry of Mugil cephalus Linnaeus are collected for pond culture from December to March, when they are abundant in shallow coastal bays, estuaries, and brackish-water streams. The fry ascend the streams on the flood tides to feed and are caught by the fishermen in basket-like nets. During the 4 hours of slack water a good day's catch may amount to some 3,000 fry, worth from $2.00 to $6.00. The fry are placed in the large ponds immediately, with no intermediate period in rearing ponds.

Progressive fish farmers of the new territories, according to Lin, always obtain their mullet fry from reliable sources. The following is considered a successful stocking formula for a pond of 50 mow (10 acres); grass carp (2-4 inches), 2,500-3,000; mixed silver carp and big-head (3 inches), 5,000; mud carp (about 2 inches), 30,000-40,000; common carp (2 inches), 20,000; grey mullet (1-1 3/4 inches), 50,000-80,000; bream (2 inches), 300 or less. One or two of these species may be omitted, and the number of mullet increased or decreased, but in all cases mullet must be the most numerous species in the pond. When the mullet reach a size of 5 inches, some are removed by cast nets for market each day to prevent overcrowding.

The amount of food fed pondfish in general varies with the judgment of the fish farmer. Overfeeding in the hot summer is perilous, and underfeeding means no growth. The chief pond-keeper takes a walk around the ponds early every morning, "observes how the silver carp and the big-head are 'chewing' the water on the surface, the movement of other fishes and the color of the water," and so decides the correct amount of food to be given.

BEWARE OF THE BROKEN EGG!

A POSSIBLE CAUSE OF HEAVY LOSSES OF SALMON EGGS

By G. Clifford Carl
Cowichan Lake Hatchery, B. C.
Fisheries Research Board of Canada
and
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DURING THE OPERATION of the Cowichan Lake Hatchery under the direction of the Fisheries Research Board of Canada, heavy losses of spring and coho salmon eggs were experienced. For example, during the 1938 season losses of eggs from 15 coho salmon (Oncorhynchus kisutch) taken by expression in the usual manner ranged from 2.4 to 98.7 percent with an average loss per fish of 26.8 percent. During the same season, egg losses from 20 spring salmon (O. tschawytscha) varied from 8.2 to 89.2 percent with an average of 39.7 percent per fish. Similar losses had been suffered in former years but no accurate records of these exist except for the season of 1935, when spring salmon egg losses averaged 46.4 percent.

The egg-taking methods apparently were no different from those employed successfully at other hatcheries and the egg lots appeared to be quite normal until the eyed stage had been reached, after which time dead eggs began to appear in large numbers. Critical examination of the eggs at this time revealed that dead eggs contained no embryo and moreover that many apparently living eggs were infertile. Agitation of the hatchery baskets at this stage, which normally does not affect living eggs, caused most of the infertile eggs to turn white in a few minutes.

In an effort to determine the cause or causes of these high mortality rates for eggs, a series of experiments was commenced in 1937 and was continued through 1938 and 1939. In the course of the investigations various phases in the technique of egg-taking were studied, particularly those concerned with methods of stripping fish and handling eggs. While most of the results are of little interest to fish-culturists in general, those of one set of experiments may be of particular significance and accordingly are given here.

BROKEN EGGS FOUND TO PRODUCE MORTALITY

In the search for causes of heavy egg losses, the eggs produced by each pair of fish were kept in separate baskets and records were kept for each lot. While washing these individual lots of eggs it was noted that sometimes shells of broken eggs were present in considerable numbers. Since these lots almost invariably suffered high losses during the incubation period, it was decided to investigate the possible connection between broken eggs and abnormal mortality.

In a preliminary experiment, eggs taken from one fish by incision were divided into two portions, each containing about 1,500 eggs. To one portion was added the material from about 120 eggs ruptured by squeezing between the fingers. Both lots were thoroughly mixed without the addition of water. Equal quantities of milt were then added and the eggs were stirred and washed in the usual way. The experiment was performed in duplicate with the following results: Lot A-loss with untreated eggs, 10.8 percent; loss with broken eggs added, 99.9 percent; Lot B--loss with untreated eggs, 4.4 percent; loss with broken eggs added, 91.5 percent.

In a second experiment eggs taken by incision from 2 fish were mixed and divided into 7 portions, each containing about 600 eggs. To each lot the yolk from various known numbers of broken eggs was added without water, after which the mixture was stirred with a feather, fertilized and washed in the usual way. The results of this experiment, carried out in duplicate, are given in Table 1.

Table 1. Effect of adding known numbers of broken eggs to 600 unbroken coho salmon eggs before fertilization

Number of broken eggs added	Percentage loss	
	A	B
0	12.2	5.0
5	25.2	5.2
10	37.5	15.5
15	76.2	72.0
20	79.2	100.0
40	97.0	99.4
80	100.0	100.0

It will be seen that the addition of 10 broken eggs to 600 unbroken eggs resulted in considerably increased losses while the presence of 80 ruptured eggs in 600 resulted in a total loss in both cases. It is evident from these experiments that the presence of material from ruptured eggs seems to result in heavy losses.

With regard to the mechanism by which egg yolk interferes with the normal development of unbroken eggs one theory may be advanced. Since the substance freed by ruptured eggs coagulates on the addition of water, it seems possible that this material forms an albuminous coat around eggs in contact with it and prevents the normal entrance of the sperm. Even if the so-called "dry method" is employed and milt is added before the water, this condition may exist since it has been demonstrated that the sperms do not become active until water has been added.

This theory is partially supported by the results of attempting to remove yolk material by rinsing a mixture of broken and unbroken eggs with salt solution before adding the milt. Although this series of experiments is incomplete, it was discovered that egg yolk remained uncoagulated in salt solution isotonic with egg content (approximately 0.6 percent NaCl in the case of coho salmon) and that part of the deleterious effect of egg yolk could be removed by washing eggs in this solution.

These results and theories may suggest many possibilities to the practical fish-culturist. For example, the high loss which is usually suffered by egg lots containing many broken shells may be due to the presence of yolk material. Broken eggs in such lots may be the result of faulty technique in stripping, or of injuries received by the fish before or during capture. Moreover, it may be possible to remove part or all of the yolk material, when it is known to be present, by rinsing the eggs, before fertilization, with isotonic salt solution.

The experiments outlined herein are far from being complete. Although the results cannot be said to be conclusive, they suggest possibilities that should be investigated further. Since it is unlikely that this type of work will be resumed at this hatchery for some time, the results and suggestions are given here so that they may be of use to others.

COMMENTS FROM OUR READERS

The Calomel Controversy

EDITOR, The PROGRESSIVE FISH-CULTURIST:

In the July-October issue of the PROGRESSIVE FISH-CULTURIST there appeared two articles concerning the effect of calomel in the diet of fingerling trout and salmon. One article, by Richard T. Smith and Elmer Quistorff of the Washington State Department of Fisheries, advocated the use of calomel in the diet of fingerling fish; the other, a preliminary report by Dr. Frederic F. Fish and myself, recommended the use of a new drug, carbarsone, rather than the conventional calomel treatment for eradicating octomitiasis.

I read with interest your note stating that the two articles presented divergent opinions as to the effect of calomel on treated fish. Regardless of expressed opinions, a similar treatment of the data from both experiments appears to result in the similar conclusion that the feeding of calomel may be accompanied by undue losses. I believe the data, as presented by Smith and Quistorff, definitely indicate that the feeding of calomel in the diet of silver and chinook salmon was detrimental, as an increase in the average mortality among the calomel-treated groups during the period of treament was experienced.

Smith and Quistorff used the so-called "observational period" when arriving at the conclusion that calomel in the diet is beneficial to fish; they found a lower average mortality in the groups of calomel-fed fish during the two weeks after the final feeding of calomel.

From my own observations made during the course of various uncomplicated calomel treatments, any losses involved appeared quite as one might expect from acute mercury poisoning--the losses were immediate in their appearance and they rapidly subsided to a temporary sub-normal level upon the cessation of further treatment.

The fish used by Smith and Quistorff were stated to be healthy fish free from infection of any kind. It is, therefore, very probable that a chemical strong enough to kill the weaker of healthy fish during the period of treatment would bring about a compensation for that mortality after the termination of treatment. It is well-known among hatcherymen that any treatment which kills the weak fish will result in a sudden increase in mortality followed by a corresponding decline during the next few days after the treatment, as the weaker fish which would normally die during the post-treatment period were prematurely killed by the treatment.

In view of these observations it is my opinion that any short-term tests upon the possible toxicity of calomel should be based upon mortalities incurred during the period of treatment and not upon those occurring during the subsequent "observational period" as used by Smith and Quistorff. The losses during the "observational period" might well be at a sub-normal level in the treated troughs as a direct result of the weaker fish having been killed by the treatment.

If the data of Smith and Quistorff, excluding diet number 2 which they stated to be unduly toxic, are analyzed on the basis of mortality during the period of treatment instead of during the "observational period", a loss of approximately 0.875 percent occurred on the four untreated control lots whereas almost twice this loss--approximately 1.45 percent--occurred among the calomel-fed fish.

Percentage of mortality during the period of treatment
(Data of Smith and Quistorff)

Species	Control	Medicated (diet 1)
Lewis River fall chinook salmon	1.4	1.1
Kalama River fall chinook salmon	0.0	1.1
Lewis River silver salmon	0.4	0.4
Lewis River silver salmon post-larvae	1.7	3.2
Total average mortality	0.875	1.45

It is my opinion also that the statement by Smith and Quistorff, "the addition of 0.2 percent calomel to the diet was beneficial in most cases and fish receiving it in their diets were found to grow faster than those on the control diet," should be markedly qualified. To my knowledge, no compound of mercury is ever used as a tonic. In view of its well-known properties, both as an acute and a chronic poison, the feeding of mercury in any form--even calomel--is a dangerous practice at best. It is quite possible that the apparent slight differences in weight recorded by Smith and Quistorff may be due to the errors inherent in all known methods for weighing live fish.

Therefore, I believe that further investigation upon the effects of calomel is definitely indicated before any definite conclusions are warranted.

Donald L. McKernan
West Coast Pathology Laboratory
Fish and Wildlife Service
Seattle, Washington

Reducing Suffocation of Fry in Troughs

EDITOR, The PROGRESSIVE FISH-CULTURIST:

For years we have found it necessary at the Manchester Station to feather and move our fry about in the troughs each night to avoid the smothering caused by bunching in the corners. We have tried various methods to eliminate this loss but without much success. We tried several lighting effects, placing a light framework covered with tarpaper over the troughs, and using spreaders in the troughs.

A very simple remedy was finally found. Instead of covering the entire trough, one cover about 5 feet long was placed about the middle. The fry were attracted to the center of the trough instead of the corners, and smothering has been practically eliminated. We have used this plan for the past 3 or 4 years and have found it very successful.

G. H. Gill
Superintendent Manchester (Iowa) Station
Fish and Wildlife Service

Two Comments on "The Hatchery Log"

EDITOR, The PROGRESSIVE FISH-CULTURIST:

I am referring to an article in the PROGRESSIVE FISH-CULTURIST, November-December 1940 issue, entitled "Hatchery Log." This article appears to be written by the same person, and with the same thought, as a previous article which appeared in the May-June 1940 issue.

To the average person, it would seem to be of a humorous nature, but underlying both articles is a line of thought which has common ground in what appears to be a whispering campaign against our Division. The writer is a member of the Division of Fish Culture and he, as well as many other officials of the Service, began work as a laborer at $45 a month. Records will show that about every man in the Service in a responsible position came up from the ranks.

The author of these two articles lacked the intestinal fortitude to sign his name as the author, and I cannot help believe but that these articles were written by someone with the idea of injuring the Division of Fish Culture. As a matter of fact, about every progressive idea in fish-cultural work in my experience originated in the Division of Fish Culture.

Possibly the salaries are low, but that is no fault of the Division. If Congress failed to make what we considered adequate provision for increase, no one lost interest but went ahead and did the work just as thoroughly and efficiently as he was able.

If the author and others responsible for these anonymous articles would spend the time and effort to give the field service a real contribution that would make for better fish-cultural practices, it is believed not only our own Service but the general public as well would be better served.

The article would lead one to believe that the men in charge of the work, either in the field or in the office, never requested their associates to give their opinions on the work or permitted free expressions of their suggestions for the betterment of the work. This is known to be an absolute untruth, because in my experience in the Service with the Division chief and the superintendents I have worked under we have always had that opportunity, and it has always been understood with the fellows with whom I have been associated in this region that we could always come in and give our ideas. If we were of the opinion that a piece of apparatus would not work, at the same time we considered the possibility that we might have missed something, and invariably we were told to go ahead and try it out, with the hope that it would enable us to perform our duties in a more capable manner.

If the PROGRESSIVE FISH-CULTURIST can serve no more useful purpose than to publish anonymous articles that have for their aim a campaign of vilification of the men in the Service, it would seem that it should be discontinued.

C. F. Culler, Regional Director
Division of Fish Culture
La Crosse, Wisconsin

EDITOR, The PROGRESSIVE FISH-CULTURIST:

Very much interested in the Hatchery Log contribution in your December issue of the PROGRESSIVE FISH-CULTURIST. A very important message was contributed on these two pages. Most of the complaints are imaginary ills. I personally worked for a man like the Superintendent mentioned in that log, so know what is meant. I night-watched for him, was foreman for him, and later took his position when it became vacant.

But I ask you, because you work for a man like that do you have to be deaf, dumb and blind? What is going to stop you from seeing how he operates his hatchery or hearing his instructions on treating fish or asking the man who does the treating or figuring out when you could improve on his methods to advantage? Wake up, down-trodden fish-culturists, and use your heads for something besides a hat rack. Let's hear some more of this log.

H. L. Peterson, District Superintendent
Fisheries Operations
Grayling, Michigan

MEASURES TO RESTORE WHITEFISH AND LAKE TROUT URGED

LANSING, MICHIGAN, February 28.--Further investigation of the relative value of artificial and natural propagation of whitefish and lake trout by the federal Fish and Wildlife Service is recommended by the Fishery Advisory Committee of the U. S. Department of the Interior.

The Committee asks that the Service's budget get sufficient funds to do the job "at the earliest possible time",in consideration of reduced whitefish catches in Lakes Huron and Michigan, and the decline in the abundance of lake trout in these lakes and Lake Superior.

Among some commercial fishermen there is much discussion of getting more hatcheries to stock Great Lakes waters with commercial species of fish.

In accordance with laws enacted by the Legislature, the Michigan Department of Conservation has concentrated on promoting natural reproduction of these fish through regulation of seasons, nets and waters to be fished. Its hatcheries in 1940 produced 17,250,000 lake trout fry and fingerling, 86,670,000 walleye (yellow pike) fry, and 435,000 whitefish fry for Great Lakes waters. Federal hatcheries in Michigan stocked another 1,000,000 lake trout fingerling in the State's Great Lakes waters last year.

ABSTRACTS

SIXTH ANNUAL MIDWEST WILDLIFE CONFERENCE

THE SIXTH Annual Midwest Wildlife Conference was held November 14, 15, and 16, 1940, under auspices of the Illinois Natural History Survey on the University of Illinois campus, Urbana. Dr. T. H. Frison, Survey Chief, acted as general chairman of arrangements. Kansas and Oklahoma were represented in addition to Illinois, Indiana, Iowa, Michigan, Minnesota, Missouri, Ohio, and Wisconsin, the States usually participating.

A general session on conservation problems, many of them relating to fish, occupied the opening morning. Group conferences of interest to fish technicians were held the afternoon of the first day and the morning of the second. Dr. Walter H. Chute, Director of the John G. Shedd Aquarium, Chicago,and Dr. Arthur D. Hasler of the University of Wisconsin presided at the fish sessions. Dedication of the Natural Resources Building, new home of the Illinois Natural History Survey, took place on the afternoon of November 15. A field trip, led by Dr. David H. Thompson of the Illinois Natural History Survey, was made the last day to State parks in which fish management programs are in progress.

Through the courtesy of Dr. Frison, abstracts or copies of most of the fish papers were made available to the PROGRESSIVE FISH-CULTURIST.

THE TIME OF ANNULUS FORMATION ON THE SCALES OF CERTAIN MICHIGAN GAME FISHES

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Michigan Department of Conservation
Ann Arbor, Michigan

The study was made to determine the time at which the annulus formed on the scales of Michigan game fishes with a view to providing the means for a more accurate age determination of the fish taken in spring and early summer.

Seven lakes and a pond were selected for the monthly collecting of samples. Additional data were obtained from several other lakes in connection with other investigations.

It was found that the date of annulus formation varies with latitude, becoming progressively later toward the north. In the southern one-third of the Lower Peninsula (Section 1) the year mark is formed by the middle of May. In the northern two-thirds of the Lower Peninsula (Section 2), this mark is laid down by the first part of June. In the Upper Peninsula (Section 3), it is completed by the first part of July.

Spawning has little effect on the time of annulus formation. There is a correlation with the age of the fish,for those over 6 years old form their annulus later than those under 6 years. The effect of temperature, apparent in the later time of forming in the northern part of the State, was studied more precisely by means of a thermograph record taken in one lake. The annulus formed during the week when the water temperature increased 7.2° F. over the preceding week.

OBSERVATIONS ON MISSOURI OZARK STREAMS AND GAME FISHES

George A. Turney
Staff Assistant, Clark National Forest

Observations on representative streams indicate that poor land makes poor fish. Investigations suggest deficiencies in fertility and aquatic vegetation, and growth studies suggest that the principal deficiency is in food for "fry" and small fingerling sizes. Five or six summers' growths are required to produce a legal-size fish.

Streams are classified according to physical characteristics and habitat suitability for different species of fish as guides to stocking programs.

High water in the spring and shifting gravel beds seriously hamper maintenance of aquatic vegetation and foods of small-size fishes are influenced correspondingly. Until stream headwaters are under good control few stream improvements are feasible as aids to reestablishment of aquatic vegetation. To get through the "bottle neck," experiments in liberation of advanced fingerlings are being carried on but have not been conducted long enough to be conclusive. It is possible to rear small-mouthed black bass, for instance, in fertilized ponds to a size equivalent to a 3-year-old in 3 to 4 months.

THE FOOD OF THE BLACK CRAPPIE, POMOXIS NIGRO-MACULATUS, IN WISCONSIN WATERS

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The analysis of the food of the black crappie was based on 282 stomachs collected from North Twin Lake, Silver Lake, and Big Round Lake in northwestern Wisconsin, at various dates during the period July 18, 1939, to February 1, 1940. Specimens were collected by various gear: 182 in inch mesh, bar measure, trap nets; 84 by hook and line; and 16 by minnow seine. Fish as food usually outranked the invertebrates in importance on the basis of percentages by volume, although the reverse was true on the basis of percentages by number. In Silver Lake, mayfly nymphs were present in 44 percent and fish in 38.7 percent of the stomachs, but the fish accounted for 88.2 percent and the nymphs only 2.7 percent of the total volume of food. In North Twin Lake, Chironomus larvae were present in 73.3 percent, and fish in 33.3 percent of the stomachs, but the fish accounted for 59.0 percent and the larvae 3.0 percent of the total volume of food. In Big Round Lake, in the July collection, Leptodora was found in 88.4 percent and fish in 16.7 percent of the stomachs, while Leptodora accounted for 22.3 percent and fish only 7.4 percent of the total volume of food. In the January and February collections at Big Round Lake, Leptodora and fish were absent from the diet and Chaoborus larvae were found in 94-97 percent of the stomachs, accounting for 30-50 percent of the total volume of food. The diet is definitely omnivorous, appears to depend chiefly on the availability and the abundance of food types, but shows a consistent selectivity for fish as food. Fish appeared in the diet only of crappies over 14 centimeters in standard length. About one-third of the crappies were feeding on other fish, which included blunt-nosed minnows, perch, bluegills, and largemouth black bass fingerlings. About 9 percent of all the crappies had one, and sometimes two or three fingerling bass in their stomachs.

CONTROLLING POPULATIONS OF NOXIOUS FISHES

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A survey of the control of "obnoxious predatory fishes" in the north central states shows that control operations have yet to be based on a scientifically ascertained need. Further, effects or results have never been measured. A summary of food and population studies of gars and bowfin (grindle) indicates that a general need for control probably does not exist and that reducing populations of such forms can never alone yield the results desired by fishermen. The need is not for more control of predators, but for better use of available information. There are still many people who do not know that not all predators are vermin.

PONDS AS A FACTOR IN FISH, GAME, AND FUR-ANIMAL RESTORATION

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Urbana, Illinois

Hundreds of artificial lakes and ponds, most of them less than 10 acres in area, are being constructed in Illinois by various governmental and sportsmen's organizations. Management practices are being developed which can be projected to larger waters.

Artificial lakes often furnish poor fishing because of improper stocking and management. Complete fish censuses of two small lakes in this category were made in 1939 and 1940. Although stocked less than 4 years, both contained tremendous numbers of stunted fish. Hook-and-line fish of desirable sizes made up less than 5 percent of the total population.

In central Illinois, new artificial lakes (2 to 6 years old) are much less productive of fish than old lakes (15 to 20 years old). As rich top soil is washed into the lakes from their drainage basins their fertility increases. Two 4-year-old lakes contained respectively 229.7 and 220.8 pounds of fish per acre, while 4 old lakes of about the same size and in the same region averaged nearly 550.0 pounds per acre.

In 7 new lakes near Rushville, Indiana, experimental stocking studies are being made. Bluegill breeders average 0.18 pound when stocked, and 1 year later from 0.26 pound in the poorest lake to 0.54 pound in the best. Maximum size was attained in the lake stocked at the rate of 37 per acre. Here the average weight increase was nearly 300 percent in a single season.

Small artificial lakes are of economic value from the standpoint of the fish, fur, and game they produce. Owners can lease duck-hunting privileges at the rate of $10 to $15 per acre, per season, and fishing privileges at 25 cents per day, which in well-managed lakes may net as much as $500 during the spring, summer and fall.--R.L.C.

MINNESOTA FISH YIELD STUDIES FOR 1940

Samuel Eddy
University of Minnesota
and
Minnesota Department of Conservation

General creel censuses were made by game wardens on 126 lakes in January 1941 and on 76 lakes in July 1940. All were typical central Minnesota lakes. The average winter catch, taken at the rate of 1.36 fish per man-hour, consisted of 64 percent crappies, 19 percent perch, and the remaining 17 percent largely pickerel and wall-eyed pike. The catch for the preceding year (census in December rather than January) averaged 2.10 per man-hour. The average summer catch for July 1940 was 1.78 fish per man-hour, with sunfishes comprising 50 percent of the catch, crappies 24 percent, and other popular game fishes from 2 to 7 percent each. The catch per man-hour for the preceding year was 1.73 fish.

Complete creel censuses conducted by C.C.C. units throughout the 1940 fishing season on northern lakes afforded interesting comparisons. Deer Lake, containing 1845 acres, yielded 2208 fish, mostly pickerel and wall-eyed pike, an average of 2.64 pounds per acre. The rate per man-hour was 1.37 fish. Island Lake of 383 acres yielded 1518 fish, mostly largemouth black bass and sunfishes, and averaged 2.56 pounds per acre. The rate per man-hour was 1.4 fish. Eighth Crow Wing Lake, containing 492 acres, yielded 11,555 fish, mostly sunfishes and crappies, averaging 19 pounds, 1.42 ounces per acre. The rate per man-hour was 1.96 fish.-R.L.C.

A Correction

Through an unfortunate error, several lines were omitted from the abstract of a paper entitled PARASITES OF FISH OF ALGONQUIN PARK LAKES, by Ralph V.Bangham, College of Wooster, Wooster, Ohio, published in the November-December issue, p. 36. The correct version of the abstract is printed below:

In the study of the parasites of fish from lakes in Algonquin Park, Ontario, 560 fish of 22 species were examined and 84.3 percent carried at least one form. Many of the fish carried larval trematodes which have fish-eating birds as their definitive hosts. Lakes containing smallmouth black bass had several species of fish infested with larval cysts of the cestode, Proteocephalus ambloplitis (Leidy). Fish from lakes that did not contain smallmouth black bass did not carry this cestode. Proteocephalus fluviatilis Bangham, described previously only as a parasite of stream bass, was secured in bass from 7 Algonquin Park lakes. A leech, Actinobdella triannulata Moore, not previously reported as a fish parasite, was found on 24 percent of the common suckers. Ten species of fish examined were of the family Cyprinidae. Of these minnows 64.4 percent were infested with at least one species of parasite. The parasites of the minnows were of few different species and the majority of the parasites were larval. The 12 remaining species of fish had 97.5 percent infestation in those that were examined. The distribution of fish parasites from the 11 lakes where parasitized fish were secured is discussed.

(Continued from inside front cover)

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